Western Pacific Fishery Management Council
Essential Fish Habitat Designations

(Source: Western Pacific Fishery Management Council. September 1998. Magnuson-Stevens Act Definitions and Required Provisions.)

Bottomfish Habitat

Identification of BMUS EFH

Except for several of the major commercial species, very little is known about the life histories, habitat utilization patterns, food habits for spawning behavior of most adult bottomfish and seamount groundfish species. Furthermore, very little is known about the distribution and habitat requirements of juvenile bottomfish.

Generally, the distribution of adult bottomfish in the western Pacific region is closely linked to suitable physical habitat. Unlike the US mainland with its continental shelf ecosystems, Pacific islands are primarily volcanic peaks with steep drop-offs and limited shelf ecosystems. The bottomfish management unit species (BMUS) under the Council's jurisdiction are found concentrated on the steep slopes of deepwater banks. The 100-fathom isobath is commonly used as an index of bottomfish habitat. Adult bottomfish are usually found in habitats characterized by a hard substrate of high structural complexity. The total extent and geographic distribution of the preferred habitat of bottomfish is not well known. Bottomfish populations are not evenly distributed within their natural habitat; instead they are found dispersed in a non-random, patchy fashion. Deepwater snappers tend to aggregate in association with prominent underwater features, such as headlands and promontories.

There is regional variation in species composition, as well as a relative abundance of the management unit specis (MUS) of the deepwater bottomfish complex in the sestern Pacific region. In American Samoa, Guam and the Northern Mariana Islands the bottomfish fishery can be divided into two distinct fisheries, a shallow- and a deep-water bottomfish fishery, based on species and depth. The shallow-water (0-100 m) bottomfish complex is comprised of groupers, snappers and jacks in the genera Lethrinus, Lutjanus, Epinephelus, Aprion, Caranx, Variola and Cephalopholis. The deep-water (100-400 m) bottomfish complex is primarily comprised of snappers and groupers in the genera Pristipomoides, Etelis, Aphareus, Epinephelus and Cephalopholis. In Hawaii the bottomfish fishery targets several species of eteline snappers, carangids and a single species of groupers. The target species are generally found at depths of 50-270 m.

To reduce the complexity and the number of EFH identifications for individual species and life stages, the Council has designated EFH for bottom fish assemblages pursuant to Section 600.805(b) of 62 FR 66551. The species complex designations include deep-slope bottom fish (shallow- and deep-water) and seamount groundfish complexes. The designation of these complexes is based upon the ecological relationships among species and their preferred habitats. These species complexes are grouped by the known depth distributions of individual BMUs. These are summarized in table 4.3.a. For a broader description of the life history and habitat utilization patterns of individual BMUS see Appendix 3.

Table 4.3.a: Management unit species complexes for bottomfish

Bottomfish	**Shallow-water species (0-100 m)** Uku (*Aprion virescens*), Thicklip trevally (*Pseudocaranx dentex*), Lunartail grouper (*Variola louti*), Blacktip grouper *(Epinephelus fasciatus*), Ambon emperor *(Lethrinus amboinensis)*, Redgill emperor *(Lethrinus rubrioperculatus*), Giant trevally (*Caranx ignoblis*), Black trevally (*Caranx lugubris*), Amberjack (*Seriola dumerili*), Taape (*Lutjanus kasmira*)

	Deep-water species (100-400 m) Ehu (*Etelis carbunculus*), Onaga (*Etelis coruscans*), Opakapaka (*Pristipomoides filamentosus*), Yellowtail Kalekale (*Pristipomoides auricilla*), Yelloweye opakapaka (*Pristipomoides flavipinnis*), Kaledale (*Pristipomoides sieboldii*), Gindai (*Pristipomoides zonatus*), Hapupuu (*Fpinephelus quernus*), Lehi (*Aphareus rutilans*)
Seamount Groundfish	Armorhead (*Pseudopentaceros richardsoni*), Ratfish/butterfish *(Hyperoglyphe japonica),* Alfonsin (*Beryx splendens*)

At present, there is not enough data on the relative productivity of different habitats to develop EFH designations based on Level 3 or Level 4 data. Given the uncertainty concerning the life histories and habitat requirements of many BMUS, the Council designated EFH for adult and juvenile bottomfish as the water column and all bottom habitat extending from the shoreline to a depth of 400 m (200 fathoms) encompassing the steep drop-offs and high relief habitats that are important for bottomfish.

The eggs and larvae of all BMUS are pelagic, floating at the surface until hatching and subject thereafter to advection by the prevailing ocean currents. There have been few taxonomic studies of these life stages of snappers (lutjanids) and groupers (epinepheline serranids). Presently, few larvae can be identified to species. As snapper and grouper larvae are rarely collected in plankton surveys, it is extremely difficult to study their distribution. Because of the existing scientific uncertainty about the distribution of the eggs and larvae of bottomfish, the Council designated the water column extending from the shoreline to the outer boundary of the EEZ to a depth of 400 m as EFH for bottomfish eggs and larvae.

In the past, a large-scale foreign seamount groundfish fishery extended throughout the southeastern reaches of the northern Hawaiian Ridge. The seamount groundfish complex consists of three species (pelagic armorheads, alfonsins and ratfish). These species dwell at 200-600 m on the submarine slopes and summits of seamounts. A collapse of the seamount groundfish stocks has resulted in a greatly reduced yield in recent years. Although a moratorium on the harvest of the seamount groundfish within the EEZ has been in place since 1986, no substantial recovery of the stocks has been observed. Historically, there has been no domestic seamount groundfish fishery.

The life histories and distribution patterns of seamount groundfish are also poorly understood. Data are lacking on the effects of oceanographic variability on migration and recruitment of individual management unit species. Based upon the best available data, the Council designated the EFH for the adult life stage of the seamount groundfish complex as all waters and bottom habitat bounded by latitude 29° - 35°N and longitude 171 °E - 179°W between 8000 m. EFH for eggs, larvae and juveniles is the epipelagic zone (~ 200 m) of all waters bounded by latitude 29 ° - 3 5°N and longitude 171°E - 179°W. This EFH designation encompasses the Hancock Seamounts, part of the northern extent of the Hawaiian Ridge, located 1,500 nautical miles northwest of Honolulu.

Habitat Areas of Particular Concern (HAPC)

Based on the known distribution and habitat requirements of adult bottomfish, the Council designated all escarpments/slopes between 40-280 m as HAPC. In addition, the Council designated the three known areas of juvenile opakapaka habitat (two off Oahu and one off Molokai) as HAPC. The basis for this designation is the ecological function these areas provide, the rarity of the habitat and the susceptibility of these areas to human-induced environmental degradation. Off Oahu juvenile snappers occupy a flat, open bottom of primarily soft substrate in depths ranging from 40 to 73 m. This habitat

is quite different from that utilized by adult snappers. Surveys suggest that the preferred habitat of juvenile opakapaka in the waters around Hawaii represents only a small fraction of the total habitat at the appropriate depths. Areas of flat featureless bottom have typically been thought of as providing low value fishery habitat. It is possible that juvenile snappers occur in other habitat types but in such low densities that they have yet to be observed.

The recent discovery of concentrations of juvenile snappers in relatively shallow water and featureless bottom habitat indicates the need for more research to help identify, map and study nursery habitat for juvenile snapper.

Pelagic Habitat

Identification of PMUS EFH

Pelagic Management Unit Species (PMUS) under the Council's jurisdiction are found in tropical and temperate waters throughout the Pacific Ocean. Variations in the distribution and abundance of PMUS are affected by ever changing oceanic environmental conditions including water temperature, current patterns and the availability of food. There are large gaps in the scientific knowledge about basic life histories and habitat requirements of many PMUS. The migration patterns of PMUS stocks in the Pacific Ocean are poorly understood and difficult to categorize despite extensive tagging studies for many species. Little is known about the distribution and habitat requirements of the juvenile life stages of tuna and billfish after they leave the plankton until they recruit to fisheries. Since spawning and larvae occur only in tropical temperatures (including temperate summer), the pre-recruit sizes are probably more tropically distributed than recruits, and juvenile tunas of this size (1-15 cm) are only caught in large numbers around tropical archipelagoes. Very little is known about the habitat of different life history stages of PMUS that are not targeted by fisheries (i.e., sharks, Gempylids, etc). For these reasons, the Council has adopted a precautionary approach in designating EFH for PMUS.

To reduce the complexity and the number of EFH identifications required for individual species and life stages, the Council has designated EFH for pelagic species assemblages pursuant to Section 60C.805(b) of 62 FR 66551. The species complex designations for the PMUS are marketable species, non-marketable species and sharks (Table 4.3.b). The designation of these complexes is based upon the ecological relationships among species and their preferred habitat. The marketable species complex has been subdivided into tropical and temperate assemblages. The temperate species complex includes those PMUS that are found in greater abundance in higher latitudes such as swordfish and bigeye, bluefin and albacore tuna. In reality all PMUS are tropical. For a broader description of the life history and habitat utilization patterns of individual PMUS see Appendix 3.

Table 4.3.b: Species complexes for pelagic management unit species

Marketable	**Temperate species**
	Striped Marlin *(Tetrapurus audax);* Bluefin Tuna *(Thunnus thynnus);* Swordfish *(Xiphias gladius);* Albacore *(Thunnus alalunga);* Mackeral *(Scomber* spp); Bigeye *(Thunnus obesus);* Pomfret (family Bramidae)

	Tropical species Yellowfin *(Thunnus albacares);* Kawakawa *(Euthynnus afnis);* Skipjack *(Katsuwonus pelamis);* Frigate and bullet tunas *(Auxis thazard. A. rochei);* Blue marlin *(Makaira nigricans);* Slender tunas *(Allothunnus fallai);* Black marlin *(Makaira indica);* Dogtooth tuna *(Gymnosarda unicolor);* Spearfish *(Tetrapturus spp);* Sailfish *(Istiophorus platypterus);* Mahimahi *(Coryphaena hippurus. C. equiselas); Oho (Acanihocybium-ss!sndri);* Opah (Lampris sp)
Unmarketable	Oilfish (family Gempylidae); Pomfret (family Bramidae); Crocodile shark
Sharks	Requiem sharks (family Carcharinidae); Thresher sharks (family Alopiidae); Mackeral sharks (family Lamnidae); Hammerheads sharks (family Sphyrnidae)

Because of the uncertainty about the life histories and habitat utilization patterns of many PMUS, the Council has taken a precautionary approach by adopting a 1,000 m depth as the lower bound of EFH for PMUS. Although many of the PMUS are epipelagic, bigeye tuna are abundant at depths in excess of 400 m and swordfish have been tracked to depths of 800 m. One thousand meters is the lower bound of the mesopelagic zone. The vertically migrating mesopelagic fishes and squids associated with the deep scattering layer are important prey organisms for PMUS and are seldom abundant below 1,000 m. This designation is also based on anecdotal reports of fishermen that PMUS aggregate over raised bottom topographical features as deep as 2,000 m (1,000 fathoms) or more. This belief is supported by research that indicates seabed features such as seamounts exert a strong influence over the super adjacent water column. An example of this type of influence is the doming of the thermocline that has been observed over seamounts.

The eggs and larvae of all teleost PMUS are pelagic. They are slightly buoyant when first spawned, are spread throughout the mixed layer and are subject to advection by the prevailing ocean currents. Because the eggs and larvae of the PMUS are found distributed throughout the-tropical (and in summer, the subtropical) epipelagic zone, EFH for these life stages has been designated as the epipelagic zone (-200 m) from the shoreline to the outer limit of the EEZ. The only generic variation in this distribution pattern occurs in the northern latitudes of the Hawaii EEZ, which extends farther into the temperate zone than any other EEZ covered by the plan. In these higher latitudes, eggs and larvae are rarely found during the winter months (November-February).

Habitat Areas of Particular Concern

For HAPC the Council designated the water column down to 1,000 m that lies above all seamounts and banks within the EEZ shallower than 2,000 m (1,000 fathoms). The EFH relevance of topographic features deeper than 1,000 m is due to the influence they have on the overlying mesopelagic zone. These deeper features themselves do not constitute EFH, but the waters from the surface to 1,000 m deep super adjacent to these features are designated as HAPC within the EFH. The 2,000-m depth contour captures the summits of most seamounts mentioned by fishermen, and all banks within the EEZ waters under the Councils jurisdiction. The basis for designating this areas as HAPC is the ecological function provided, the rarity of the habitat type, the susceptibility of these areas to human-induced environmental degradation and proposed activities that may stress the habitat type.

As noted above, localized areas of increased biological productivity are associated with seamounts, and many seamounts are important grounds for commercial fishing in the western Pacific region. There

have been proposals to mine the manganese rich summits of the off-axis seamounts in the Hawaii EEZ The possible adverse impacts of this proposed activity on fishery resources are of concern to the Council.

Because the PMUS are highly migratory, the areas outside the EEZ in the western Pacific region are designated by the Council as "important habitat." Vast areas outside of EEZ waters provide essential spawning, breeding and foraging habitat. The EEZ under the Council's jurisdiction represents only a small fraction of the waters in which PMUS are distributed. The Council believes that any attempt to manage PMUS stocks and protect their habitat on anything less than a Pacific basin-wide scale would be ineffective. Hence, the Council will continue its participation in all appropriate international forums and bodies involved in the management of highly migratory species.

Crustaceans Habitat

Identification of CMUS EFH

Spiny lobsters are found throughout the Indo-Pacific region. All spiny lobsters in the western Pacific region belong to the family Palinuridae. The slipper lobsters belong to the closely related family, Scyllaridae. There are 13 species of the genus *Panulirus* distributed in the tropical and subtropical Pacific between 35°N and 35°S. *P. penicillatus* is the most widely distributed, the other three species are absent from the waters of many island nations of the region. The Hawaiian spiny lobster (*P. marginatus*) is endemic to Hawaii and Johnston Atoll and is the primary species of interest in the Northwest Hawaiian Islands NWHI fishery, the principal commercial lobster fishery in the western Pacific region. This fishery also targets the slipper lobster *Scyllarides squammosus*. Three other species of lobster--pronghorn spiny lobster (*Panulirus pencillatus),* ridgeback slipper lobster (*Scyllarides haanii) and* Chinese slipper lobster (*Parribacus antarticus*)--and the Kong crab, family *Raninidae,* are taken in low numbers in the NWHI fishery.

In the NWHI there is wide variation in lobster total density, size and sex ratio between the different islands. Neither the extent of species interaction between *P. marginatus* and *Scyllarides squammosus* nor the role of density dependent factors in controlling population abundance is known.

In the Main Hawaiian Islands (MHI) most of the commercial, recreational and subsistence catches of spiny lobster are taken from waters under State jurisdiction. *P. maginatus* and *P. pencillatus* are taken in nearly equal numbers in trap samples around the island of Oahu. However, the species composition or the magnitude of the subsistence, recreational and commercial catch is not known. In America Samoa, the Northern Mariana Islands and Guam the species composition or the magnitude of the subsistence, recreational and commercial catch is also unknown.

In Hawaii adult spiny lobsters are typically found on rocky substrate in well protected areas, in crevices and under rocks. Unlike many other species of *Panulirus,* the juveniles and adults of *P. marginatus* are not found in separate habitat apart from one another. Juvenile *P. marginatus* recruit directly to adult habitat; they do not utilize separate shallow water nursery habitat apart from the adults as do many Palinurid lobsters. Similarly, juvenile and adult P. *pencillatus* also share the same habitat. P. *marginatus* is found seaward of the reefs and within the lagoons and atolls of the islands.

The reported depth distribution of P. *marginatus* is 3-200 m. While this species is found down to depths of 200 m it usually inhabits shallower waters. *P. marginatus* is most abundant in waters of 90 m or less. Large adult spiny lobsters are captured at depths as shallow as 3 m.

In the southwestern Pacific spiny lobsters are typically found in association with coral reefs. Coral reefs provide shelter as well as a diverse and abundant supply of food items. *Panulirus pencillatus* inhabits the rocky shelters in the windward surf zones of oceanic reefs and moves on to the reef flat at night to forage.

Very little is known about the planktonic phase of the phyllosoma larvae of *Panulirus marginatus.* The oceanographic and physiographic features that result in the retention of lobster larvae within the Hawaiian archipelago are poorly understood. Evidence suggests that fine scale oceanographic features, such as eddies and currents, serve to retain phyllosoma larvae within the Hawaiian Island chain. While there is a wide range of lobster densities between banks within the NVJHI, the spatial distribution of phyllosoma larvae appears to be homogenous (Polovina and Moffitt 1995).

To reduce the complexity and the number of EFH identifications required for individual species and life stages, the Council has designated EFH for crustacean species assemblages (Table 4.3.c). The species complex designations are spiny and slipper lobsters and Kona crab. The designation of these complexes is based upon the ecological relationships among species and their preferred habitat. For a broader description of the life history and habitat utilization patterns of individual crustacean management unit species (CMUS) see Appendix 3.

Table 4.3.c: Species complexes for crustacean management unit species

Spiny and Slipper Lobster Complex.....	Hawaiian spiny lobster (*Panulirus marginatus*), Spiny lobster (*Panulirus penicillatus*, Panulirus sp.) Ridgeback slipper lobster (*Scyllarides haanii*), Chinese slipper lobster (*Parribacus antarticus*),
Kona Crab.....	Kona crab (*Ranina ranina*)

At present, there is not- enough data on the relative productivity of different habitats of CMUS to develop EFH designations based on Level 3 or Level 4 data There is little data concerning growth rates, reproductive potentials and natural mortality rates at the various life history stages. The relationship between egg production, larval settlement and stock recruitment is also poorly understood. Although there is a paucity of data on the preferred depth distribution of phyllosoma larvae in Hawaii, the depth distribution of phyllosoma larvae of other species of *Panulirus* common in the Indo-Pacific region has been documented. Later stages of panulirid phyllosoma larvae have been found at depths between 80-120 m. For these reason the Council designated EFH for spiny lobster larvae as the water column from the shoreline to the outer limit of the EEZ down to a depth of 150 m. The EFH for juvenile and adult spiny lobster is designated as the bottom habitat from the shoreline to a depth of 100 m.

Habitat Areas of Particular Concern

Research indicates banks with summits less than 30 m support successful recruitment of juvenile spiny lobster while those with summit deeper than 30 m do not. For this reason, the Council has designated all banks in the NWHI with summits less than 30 m as HAPC. The basis for designating this areas as HAPC is the ecological function provided, the rarity of the habitat type and the susceptibility of these areas to human-induced environmental degradation. The complex relationships between recruitment sources and sinks of spiny lobsters is poorly understood. The Council feels that in the absence of a better understanding

of these relationships the adoption of a precautionary approach to protect and conserve habitat is warranted.

The relatively long pelagic larval phase for palinurids results in very wide dispersal of spiny lobster larvae. Palinurid larvae are transported up to 2,000 run by prevailing ocean currents. Because phyllosoma larvae are transported by the prevailing ocean currents outside of EEZ waters, the Council has identified habitat in these areas as "important habitat."

Precious Coal Habitat

Identification of Precious Corals Management Unit Species (PCMUS) EFH

In the Hawaiian Islands, precious coral beds have been found only in the deep inter-island channels and off promontories at depths between 300-1,500 m and 30-100 m. The six known beds of pink, gold and bamboo corals are Keahole Point, Makapuu, Kaena Point, Wespac, Brooks Bank and 180 Fathom Bank. Makapuu is the only bed that has been surveyed accurately enough to estimate MSY. The Wespac bed, located between Necker and Nihoa Islands in the NWHI**,** has been set aside for use in baseline studies and as a possible reproductive reserve. The harvesting of precious corals is prohibited in this area. Within the western Pacific region the only directed fishery for precious corals has occurred in the Hawaiian Islands. At present, there is no commercial harvesting of precious corals in the EEZ, but several firms have expressed interest.

Precious corals may be divided into deep-water and shallow-water species. Deep-water precious corals are generally found between 350-1,500 m and include pink coral *(Corallium secundum),* gold coral *(Gerardia sp.* and *Parazoanthus sp.)* and bamboo coral *(Lepidistis.olapa).* Shallow-water species occur between 30 and 100 m and consist primarily of three species of black coral, *Antipathes dichotoma, Antipathes grandis* and *Antipathes ulex.* In Hawaii *Antipathes dichotoma* accounts for around 90% of the commercial harvest of black coral and virtually all of it is accounts for around 90% of the commercial harvest of black coral and virtually all of it is harvested in State waters.

Precious corals are non-reef building and inhabit depth zones below the euphotic zone. They are found on solid substrate in areas that are swept relatively clean by moderate to strong (>25 cm/sec) bottom currents. Strong currents help prevent the accumulation of sediments, which would smother young coral colonies and prevent settlement of new larvae. Precious coral yields tend to be higher in areas of shell sandstone, limestone and basaltic or metamorphic rock with a limestone veneer.

Black corals are most frequently found under vertical drop-offs. Such features are common off Kauai and Maui in the MHI, suggesting that their abundance is related to suitable habitat (Grigg 1976). Off Oahu many submarine terraces that otherwise would be suitable habitat for black corals are covered with sediments. In the MHI the lower depth range of *Antipathes dichotoma* and A. grandis coincides with the top of the thermocline (ca. 100 m) (Grigg 1984).

Pink, bamboo and gold corals all have planktonic larval stages and sessile adult stages. Larvae settle on solid substrate where they form colonial branching colonies. The length of the larval stage of all species of precious corals is unknown.

The habitat sustaining precious corals is generally in pristine condition. There are no known areas that have sustained damage due to resource exploitation, notwithstanding the alleged illegal heavy foreign fishing for corals in the Hancock Seamounts area.

To reduce the complexity and the number of EFH identifications required for individual species and life stages

the Council designated EFH for precious coral assemblages (Table 4.3.d). The species complex designations are deep-water and shallow-water complexes. The designation of these complexes is based upon the ecological relationships between the individual species and their preferred habitat. For a broader description of the life history and habitat utilization patterns of individual PCMUS see Appendix 3.

Table 4.3.d: Species complexes for precious coral management unit species

Deep-Water Precious Corals (300-1500 m)	Pink coral (*Corallium recundum),* Red coral (*Corallium regaled*), Pink coral (*Corallium laauense),* Midway deepsea coral (*Corallium* sp nov.), Gold coral (*Gerardia* sp), Gold coral (*Callogorgia gilberti*), Gold coral (*Narella* spp.), Gold coral (*Calyptrophora* spp.), Bamboo coral (*Lepidisis olapa),* Bamboo coral (*Acanella* spp.),
Shallow-Water Precious Corals (20-100 m)	Black coral (*Antipathes dichotoma*), Black coral (*Antpathis grandis*), Black coral (*Antipathes ulex*)

The Council considered using the known depth range of individual PCMUS to designate EFH but rejected this alternative because of the rarity of the occurrence of suitable habitat conditions. Instead, the Council designated the six known beds of precious corals as EFH. The Council feels that the narrow EFH designation will facilitate the consultation process. In addition, the Council designated three black coral beds in the MHI-between Milolii and South Point on Hawaii, Auau Channel between Maui and Lanai and southern border of Kauai-as EFH.

Habitat Areas of Particular Concern

The Council designated three of the six precious coral beds-Makapuu, Wespac and Brooks Bank-as habitat areas of particular concern. Makapuu bed was designated as HAPC because of the ecological function it provides, the rarity of the habitat type and its sensitivity to human induced environmental degradation. The potential commercial importance and the amount of scientific information that has been collected on Makapuu bed were also considered. Wespac bed was designated as HAPC because of the ecological function it provides and the rarity of the habitat type. Its refugia status was also considered. Brooks Bank was designated HAPC because of the ecological function it provides and the rarity of the habitat type. Its possible importance as foraging habitat for the Hawaiian monk seal was also considered. For black corals the Council designated the Auau Channel as a HAPC because of the ecological function it provides, the rarity of the habitat type and its sensitivity to human-induced environmental degradation. Its commercial importance was also considered.